PROCEEDINGS

53. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

Faculty of
Mechanical Engineering

PROSPECTS IN MECHANICAL ENGINEERING

8 - 12 September 2008

www.tu-ilmenau.de

TECHNISCHE UNIVERSITÄT
ILMENAU

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

Published by
Impressum

Publisher Herausgeber	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Dr. h. c. Prof. h. c. Peter Scharff
Editor Redaktion	Referat Marketing und Studentische Angelegenheiten Andrea Schneider Fakultät für Maschinenbau Univ.-Prof. Dr.-Ing. habil. Peter Kurz, Univ.-Prof. Dr.-Ing. habil. Rainer Grünwald, Univ.-Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. mult. Gerd Jäger, Dr.-Ing Beate Schlütter, Dipl.-Ing. Silke Stauche
Editorial Deadline Redaktionsschluss	17. August 2008
Publishing House Verlag	Verlag ISLE, Betriebsstätte des ISLE e.V. Werner-von-Siemens-Str. 16, 98693 Ilmenau

CD-ROM-Version:

Implementation Realisierung	Technische Universität Ilmenau Christian Weigel, Helge Drumm
Production Herstellung	CDA Datenträger Albrechts GmbH, 98529 Suhl/Albrechts

ISBN: 978-3-938843-40-6 (CD-ROM-Version)

Online-Version:

Implementation Realisierung	Universitätsbibliothek Ilmenau ilmedia Postfach 10 05 65 98684 Ilmenau

Home / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=17534

53rd Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
08 – 12 September 2008

R. Christoph / I. Schmidt

Advances in Multisensor-Coordinate Measuring-Integration of X-ray Computed Tomography and Confocal Microscopes-

Sensors for Measuring Complete Surfaces

Advanced demands through shrinking tolerances and the increasing importance of form deviations require the measurement of the complete surface of parts with high point density. Fig. 1 shows an abstract of commercially available sensor types that fullfil these demands. A computer tomography sensor and a Laser Light Sectioning Sensor (Werth LLP) for coarse tolerances as well as a multiple autofocus method (Werth 3D Patch) for small tolerances are already integrated in Werth coordinate measuring machines. All sensors are controlled by the proven software, WinWerth®. A confocal microscope was recently implemented in the same manner to determine small dimensions with tight tolerances on micro features.

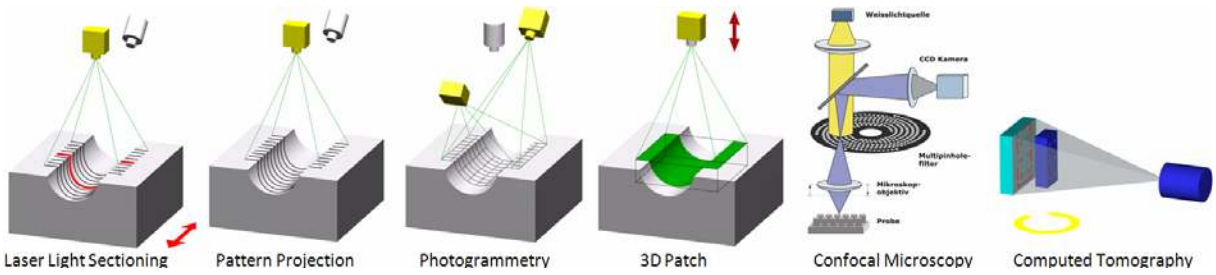

Fig. 1: Methods for determining the complete surface of an object

X-Ray Computed Tomography

The basic principle of X-ray computed tomography (CT) combines several 2D projection images of the workpiece captured in different rotational positions. These images are fed into a reconstruction algorithm to create in the end a 3D point cloud representing the entire surface. This method enables very fast first part inspections and nominal/actual value comparisons including internal geometries. By combining the CT-principle with proven CMM technology, an accurate and stable measurement system traceable to the national standards is created. Consequently a subvoxel algorithm (patent pending) can be applied to increase the measurement resolution and accuracy. In order to achieve higher magnifications and thus higher resolution and accuracy, several partial images of

an object are captured in each projection and combined into virtual images that are fed into the reconstruction algorithm. With this raster tomography algorithm, even parts larger than the CT detector size can be measured. Due to the combination of the CT sensor with various other sensors in one CMM, the accurate measurement of features with tight tolerances and multi-material parts are possible. The additional sensors can also be used to improve the accuracy of CT by correcting systematic deviations of the CT-data caused by different physical effects. In contrast to other approaches, this auto-correction directly uses the deviations between the CT-measurement and reference measurements on the same part type. It has recently been shown that the measurement uncertainty of CT-measurements can be improved to a range better than 10 µm by using optimized, stable mechanical construction. Additionally, by using the Werth auto-correction, the remaining deviations between tactile measurements and auto-corrected CT-measurements are much less than 5 µm.

Confocal Microscope (Nano Focus Probe)

The Nano Focus Probe is capable of determining parameters like micro geometries, form deviations, or roughness of complex structures with the highest accuracy [Werth 2008]. The working range is 160 µm x 160 µm to 1,6 mm x 1,6 mm, depending on the optical sensor magnification (10x to 100x). As a great advantage with the integration of this sensor features that are distributed over the entire measuring range of the CMM and distances between those features can be measured very accurately. Achievable 1D probing uncertainties according to DIN EN ISO 10360 [ISO 1] are within a range of 1,5 µm to 0,15 µm. One of the sensors special applications is layer thickness measurement. For the determination of a 100 µm lacquer coating, a standard deviation of about 60 nm was obtained.

References:

[Werth 2008] Werth Messtechnik GmbH: Produktblatt Werth Nano Focus Probe NFP, Firmenschrift der Fa. Werth Messtechnik GmbH, Gießen: 2008

[ISO 1] DIN EN ISO 10360: Geometrische Produktspezifikation (GPS) Annahmeprüfung und Bestätigungsprüfung für Koordinatenmessgeräte (KMG). Berlin: Beuth Verlag

Authors:
Dr.-Ing. habil. Ralf Christoph
Dipl.-Ing. Ingomar Schmidt
Werth Messtechnik GmbH, Siemensstraße 19
Gießen, 35394
Phone: 0641 / 7938-0
Fax: 0641 / 7938-542
E-mail: mail@werthmesstechnik.de